

Figure 2. Interrogation of a Wireless Fluid-Level Sensor is shown using the magnetic-field-response recorder.

and amplitude of each sensor are displayed. The amplitude is dependent upon distance at which the sensor is interrogated. The recorder can be programmed to display the physical value of the measurement. The magnetic-field-response recorder has an internal antenna, connector for external antenna, and an analog output.

The measurement-acquisition method has many advantages over other methods currently in use. Once electrically excited, the sensors have very low voltage. If a short does occur in the sensor, the sensor will not be electrically active because a completed circuit is needed for Far-

day induction. Hence, electrical arcing is prevented. Because the measurement system and sensors do not necessitate a physical connection to a power source or data-acquisition equipment, they are easy to implement into existing vehicles, structures, or other existing systems. The measurement system can be installed during any phase of vehicle life, and it is less costly to install new sensors than the traditional method of wiring a sensor to acquisition equipment. Such a system can be used to implement measurements that were not envisioned during design of a vehicle or structure but identified as needed during testing or operation. New

measurements only require that the new sensors be placed within the magnetic field of the interrogating antenna(s). No wiring is required. Many of the sensors and interrogating antennas can be made lightweight and non-obtrusive by directly placing on the vehicle or structural components using metallic-film deposition methods.

This work was done by Stanley E. Woodard, Qamar A. Shams, and Robert L. Fox of Langley Research Center and Virginia and Bryant D. Taylor of Swales Aerospace Corporation. Further information is contained in a TSP (see page 1). LAR-16908

Platform for Testing Robotic Vehicles on Simulated Terrain Slope, ground material, and obstacles can be varied.

NASA's Jet Propulsion Laboratory, Pasadena, California

The variable terrain tilt platform (VTTP) is a means of providing simulated terrain for mobility testing of engineering models of the Mars Exploration Rovers. The VTTP could also be used for testing the ability of other robotic land vehicles (and small vehicles

in general) to move across terrain under diverse conditions of slope and surface texture, and in the presence of obstacles of various sizes and shapes.

The VTTP consists mostly of a 16-ft- (4.88-m)-square tilt table. The tilt can be adjusted to any angle between 0°

(horizontal) and 25°. The test surface of the table can be left bare; can be covered with hard, high-friction material; or can be covered with sand, gravel, and/or other ground-simulating material or combination of materials to a thickness of as much as 6 in. (~15 cm).



A Model Robotic Vehicle was driven over 25-cm obstacles on simulated terrain at a tilt of 20°.

Models of rocks, trenches, and other obstacles can be placed on the simulated terrain.

For example, for one of the Mars-Rover tests, a high-friction mat was at-

tached to the platform, then a 6-in. (≈15 cm) deep layer of dry, loose beach sand was deposited on the mat. The choice of these two driving surface materials was meant to bound the range of

variability of terrain that the rover was expected to encounter on the Martian surface. At each of the different angles at which tests were performed, for some of the tests, rocklike concrete obstacles ranging in height from 10 to 25 cm were placed in the path of the rover (see figure).

The development of the VTTP was accompanied by development of a methodology of testing to characterize the performance and modes of failure of a vehicle under test. In addition to variations in slope, ground material, and obstacles, testing typically includes driving up-slope, down-slope, cross-slope, and at intermediate angles relative to slope. Testing includes recording of drive-motor currents, wheel speeds, articulation of suspension mechanisms, and the actual path of the vehicle over the simulated terrain. The collected data can be used to compute curves that summarize torque, speed, power-demand, and slip characteristics of wheels during the traverse.

This work was done by Randel Lindemann of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-42522

Interferometer for Low-Uncertainty Vector Metrology

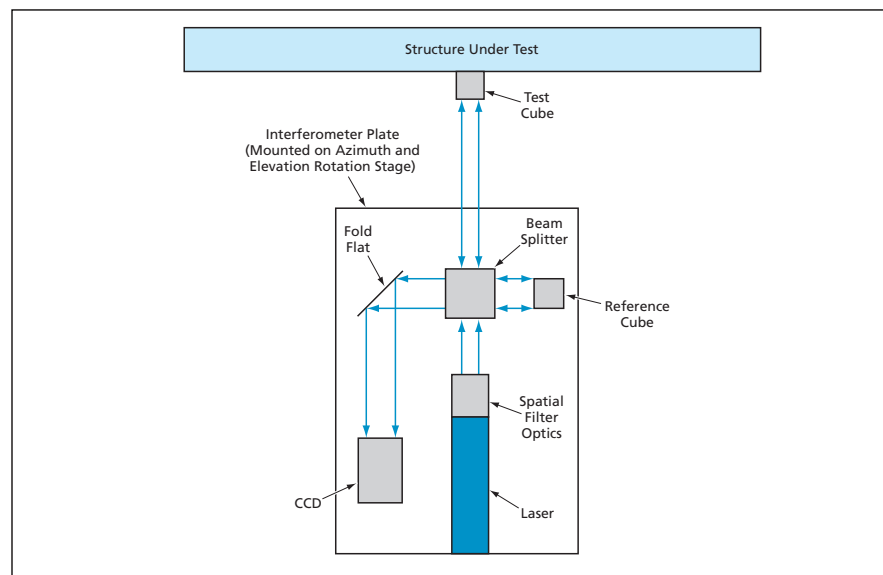
Accuracy is increased; time and cost are reduced.

Goddard Space Flight Center, Greenbelt, Maryland

The figure is a simplified schematic diagram of a tilt-sensing unequal-path interferometer set up to measure the orientation of the normal vector of one surface of a cube mounted on a structure under test. This interferometer has been named a "theoferometer" to express both its interferometric nature and the intention to use it instead of an autocollimating theodolite.

The theoferometer optics are mounted on a plate, which is in turn mounted on orthogonal air bearings for near-360° rotation in azimuth and elevation. Rough alignment of the theoferometer to the test cube is done by hand, with fine position adjustment provided by a tangent arm drive using linear inch-wormlike motors.

In the operation of the theoferometer, the interference pattern formed by the collimated laser beams reflected from the two cubes is focused onto a



In this **Interferometer**, the interference pattern formed by the laser beams from the cubes is imaged onto the CCD. This pattern would depend on the angular misalignment between the cubes and would be analyzed to determine the misalignment.